WHAT IS CLAIMED IS:

1. An ignition timing control apparatus for an internal combustion engine having a plurality of cylinders, operation of said engine being switchable between partial-cylinder operation, which operates some of the cylinders, and all-cylinder operation, which operates all of the cylinders, said ignition timing control apparatus comprising:

basic ignition timing calculating means for calculating a basic ignition timing according to an operating condition of said engine;

a knock sensor mounted on said engine;

knocking determining means for determining whether knocking has occurred based on an output of said knock sensor;

correcting means for calculating a correction amount according to a determined result from said knocking determining means to suppress knocking, and correcting the basic ignition timing using the calculated correction amount; and

learning value calculating means for calculating learning values of the correction amount calculated by said correcting means,

wherein said learning value calculating means calculates the learning values corresponding, respectively, to the partial-cylinder operation and the all-cylinder operation, and wherein said correcting means uses one of the learning values calculated by said learning value calculating means, according to the operating condition of said engine.

2. The ignition timing control apparatus according to claim 1, wherein during all-cylinder operation, said learning value calculating means calculates a first learning value to be applied in the operating condition of said engine where an exhaust gas recirculation is being performed, when the exhaust gas recirculation is being performed, and calculates a second learning value to be applied in the operating condition of said engine where the exhaust gas recirculation is not being performed, when the exhaust gas recirculation is not being performed.

3. The ignition timing control apparatus according to claim 1, wherein said basic ignition timing calculating means calculates the basic ignition timing according to a number of operating cylinders.

4. The ignition timing control apparatus according to claim 1, wherein said correcting means uses one of the learning values as the correction amount when the learning value is updated by said learning value calculating means to advance the ignition timing.

5. The ignition timing control apparatus according to claim 1, wherein said correcting means includes limit value calculating means for calculating a limit value of the correction amount using the learning values corresponding, respectively, to the partial-cylinder operation and the all-cylinder operation, and limiting means for limiting the correction amount using the limit value calculated by said limit value calculating means.

6. The ignition timing control apparatus according to claim 1, wherein said knocking determining means includes noise level calculating means for calculating a noise level based on the output of said knock sensor, gain coefficient calculating means for calculating a gain coefficient according to a number of operating cylinders, and determination threshold calculating means for calculating a determination threshold by multiplying the noise level by the gain coefficient, wherein said knocking determining means determines knocking has occurred when a maximum value of the output of said knocking sensor exceeds the determination threshold.

7. An ignition timing control method for an internal combustion engine having a plurality of cylinders, operation of said engine being switchable between partial-cylinder operation, which operates some of the cylinders, and all-cylinder operation, which operates all of the cylinders, said ignition timing control method comprising the steps of:

a) calculating a basic ignition timing according to an operating condition of said engine;

b) determining whether knocking has occurred based on an output of a knock sensor mounted on said engine;

c) calculating a correction amount according to a determined result in said step b) to suppress knocking;

d) correcting the basic ignition timing with the calculated correction amount; and

e) calculating learning values of the calculated correction amount,

wherein the learning values are calculated corresponding, respectively, to the partial-cylinder operation and the all-cylinder operation, and one of the calculated learning values is used for the correction in said step d) according to the operating condition of said engine.

8. The ignition timing control method according to claim 7, wherein during all-cylinder operation, a first learning value to be applied in an operating condition where an exhaust gas recirculation is performed is calculated when the exhaust gas recirculation is being performed, and a second learning value to be applied in an operating condition where the exhaust gas recirculation is not performed is calculated when the exhaust gas recirculation is not being performed.

9. The ignition timing control method according to claim 7, wherein the basic ignition timing is calculated according to a number of operating cylinders.

10. The ignition timing control method according to claim 7, wherein one of the learning values is used as the correction amount when the learning value is updated to advance the ignition timing.

11. The ignition timing control method according to claim 7, wherein said step c) of calculating the correction amount includes the steps of:

c1) calculating a limit value of the correction amount, using learning values corresponding, respectively, to the partial-cylinder operation and the all-cylinder operation; and

c2) limiting the correction amount using the calculated limit value.

12. The ignition timing control method according to claim 7, wherein said step b) includes the steps of:

b1) calculating a noise level based on the output of said knock sensor;

b2) calculating a gain coefficient according to a number of operating cylinders; and

b3) calculating a determination threshold by multiplying the noise level by the gain coefficient,

wherein it is determined knocking has occurred when a maximum value of the output of said knocking sensor exceeds the determination threshold.

13. A computer program for causing a computer to carry out an ignition timing control method for an internal combustion engine having a plurality of cylinders, operation of said engine being switchable between partial-cylinder operation, which operates some of the cylinders, and all-cylinder operation, which operates all of the cylinders, said ignition timing control method comprising the steps of:

a) calculating a basic ignition timing according to an operating condition of said engine;

b) determining whether knocking has occurred based on an output of a knock sensor mounted on said engine;

c) calculating a correction amount according to a determined result in said step b) to suppress knocking;

d) correcting the basic ignition timing with the calculated correction amount; and

e) calculating learning values of the calculated correction amount,

wherein the learning values are calculated corresponding, respectively, to the partial-cylinder operation and the all-cylinder operation, and one of the calculated learning values is used for the correction in said step d) according to the operating condition of said engine.

14. The computer program according to claim 13, wherein during all-cylinder operation, a first learning value to be applied in an operating condition where an exhaust gas recirculation is performed is calculated when the exhaust gas recirculation is being performed, and a second learning value to be applied in an operating condition where the exhaust gas recirculation is not performed is calculated when the exhaust gas recirculation is not being performed.

15. The computer program according to claim 13, wherein the basic ignition timing is calculated according to a number of operating cylinders.

16. The computer program according to claim 13, wherein one of the learning values is used as the correction amount when the learning value is updated to advance the ignition timing.

17. The computer program according to claim 13, wherein said step c) of calculating the correction amount includes the steps of:

c1) calculating a limit value of the correction amount, using learning values corresponding, respectively, to the partial-cylinder operation and the all-cylinder operation; and

c2) limiting the correction amount using the calculated limit value.

18. The computer program according to claim 7, wherein said step b) includes the steps of:

b1) calculating a noise level based on the output of said knock sensor;

b2) calculating a gain coefficient according to a number of operating cylinders; and

b3) calculating a determination threshold by multiplying the noise level by the gain coefficient,

wherein it is determined knocking has occurred when a maximum value of the output of said knocking sensor exceeds the determination threshold.